Aggregate Exposure Assessment: Longitudinal Surveys of Human Exposure-Related Behavior

The U.S. Environmental Protection Agency (EPA), as part of its Science to Achieve Results program, is seeking applications for longitudinal case studies to quantify the behavioral factors that lead to nonoccupational human exposures to toxic chemicals in the United States. The National Center for Environmental Research is interested in supporting national- or regional-scale surveys to develop approaches for collecting longitudinal human behavioral (activity) patterns and dietary data from statistically representative sets of individuals that can be used in assessments and models for estimating aggregate and cumulative exposures to chemicals in the environment. Of particular interest are studies incorporating methods that integrate the collection of long-term human activity pattern data, along with consumer product use and food consumption information from a statistically representative set of individuals sampled repeatedly throughout a specified time period.

This request for applications invites research proposals that develop approaches for collecting data on 1) exposure-related activities in terms of time, location, and level of activity or exertion (activity-specific energy use or equivalent metric), as a function of an individual's life stage; 2) dietary consumption, including the types and quantity of foods and beverages consumed; and/or 3) frequency and duration of use of consumer products including pesticides; household cleaners and solvents; combustion products, such as gas, kerosene, wood stoves, and fireplaces; and personal care, tobacco, and other products that may be sources of toxic chemicals in and around the home. Proposals must address 1) the development of a survey platform and approach for collecting behavioral data, 2) approaches for testing this platform through hypotheses-driven surveys, and 3) the design features of these surveys.

Innovative research is needed to develop a platform and an approach for collecting and reporting activity pattern, product use, and dietary consumption data on an ongoing basis. For example, "Web TV" provides probability samples that are currently available and may provide an efficient and effective platform for collecting this information. Applicants should describe a proposed data collection platform that will 1) allow the identification of probability-based samples of individuals that can be stratified by life stage; 2) facilitate repeated measurements (longitudinal data collection) over multiple years while minimizing the level of participant dropout and other sources of potential bias in the sample; 3) allow data collection throughout the year to describe how exposures change over days, weeks, months, and seasons; 4) minimize, estimate, and correct for the measurement errors usually associated with longitudinal data gathering efforts; and 5) efficiently integrate the field sampling methods needed to obtain different types of information while minimizing respondent burden.

The data collection platform and survey approach should be tested by hypothesis-driven surveys of activity patterns, consumer product use, and/or dietary consumption rates. Applicants should identify data needs and/or testable study hypotheses that are supported by rationales for the selection of a population of concern in terms of sample size and characteristics, geographic distribution, and temporal coverage so that intra- and interindividual variation can be adequately addressed over time. Potential testable study hypotheses include, but are not limited to, 1) the degree to which single-day or short-term diary data on activities are representative of and can be used to predict longer-term activity patterns; 2) the extent to which two-day dietary data (collected 3–10 days apart) under the U.S. Department of Agriculture's Continuing Survey of Food Intakes by Individuals is representative of and can be used to predict longer-term consumption patterns; 3) the degree to which exposure-related human behaviors within an individual remain consistent or are correlated when repeated over time; and 4) the extent to which human behavioral patterns related to environmental exposure vary with the season or time of the year.

Successful proposals will incorporate in their approach methods for collecting behavioral data that are less invasive and burdensome on the participant than methods used heretofore. In addition, successful proposals will 1) discuss how the field data-gathering effort will be organized and undertaken; 2) describe how the pilot-testing of the methods will be undertaken, and how the results of these tests will be analyzed and evaluated (including the evaluation criteria that will be used); 3) discuss the data analyses that will be undertaken and what statistical and other techniques will be used to assess the intra- and interindividual variability inherent in the factors of interest; and 4) propose credible approaches for providing public access to the data collected or for providing data to the EPA in a format compatible with the CHAD database so they can be made publicly available. Successful applicants may be required to submit quality-assured data in an electronic format as part of their annual reporting requirements.

It is anticipated that a total of approximately $10 million will be awarded, depending on the availability of funds. Depending on the hypotheses proposed and the scope of data collection activities, the funding requirements of the proposals are anticipated to fall into two categories:

1) Proposals that include collection of all three types of data are expected to range from $1,000,000 to $1,250,000 per year total costs, for up to 4 years. The EPA anticipates funding 1–2 of these proposals. Requests for amounts in excess of a total of $5,000,000, including direct and indirect costs, will not be considered.

2) Proposals that include the collection of only one type of data are expected to range from $300,000 to $500,000 per year total costs, for up to 4 years. The EPA anticipates funding 2–3 of these proposals. Requests for amounts in excess of a total of $2,000,000, including direct and indirect costs, will not be considered.

The deadline for receipt of applications is 8 May 2003. Submission information, including the necessary forms, is available at http://es.epa.gov/ncer/rfa/forms/. Complete information on this announcement is available at http://es.epa.gov/ncer/rfa/current/2003_expos_assess.html.

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Spatial Patterns in Air Pollution Emissions

The U.S. Environmental Protection Agency (EPA) announces an extramural funding competition supporting research into the consequences for air quality of global change, including climate, climate variability, land use, economic development, and technology. The EPA is interested in analysis of pollutant emissions related to tropospheric ozone and particulate matter formation that may be altered by future global changes. A better understanding of the consequences of global change for regional air quality will be useful for both fully accounting for the impacts of global change and for state and local government emission control strategies to meet National Ambient Air Quality Standards (NAAQS) for ozone and particulate matter.

The location and design of new development can affect how much it impacts the environment. For example, the physical characteristics and patterns of land development in a region can affect air quality by influencing travel mode choices, trips, trip speed, number of miles driven, and therefore mobile source emissions. Characteristics of urban form that have been found to affect trip making include density, mix of land uses, transit accessibility, pedestrian environment/urban design factors, and regional patterns of compactness with a jobs–housing balance. There is also increasing interest in developing "smart growth" strategies (such as compact, mixed-use development with a variety of transportation options and pedestrian-oriented urban form) in order to improve air quality by reducing overall auto-related emissions.

Emissions from stationary air pollution sources, such as power plants and factories, will also be affected by the characteristics and patterns of land development. In addition, economic growth, changes in the composition of economic output (GDP), and technological change have the potential to affect both the total amount and the spatial distribution of stationary source emissions. Economic growth is unlikely to proceed at the same rate in all locations across the United States. Increases in activity in the services sector, decreases in manufacturing, and other sector changes are unlikely to be geographically uniform, and as these sectors have differing emissions characteristics, the spatial pattern of emissions is likely to change. Similarly, the diffusion of new and improved technologies over time will have consequences for the amount and spatial distribution of emissions.

Land use and vegetation are known to influence the natural emission of volatile organic compounds (VOCs), carbon monoxide, and oxides of nitrogen. On a global scale, these biogenic emissions exceed similar anthropogenic emissions, although anthropogenic sources can dominate within urban areas. However, there is a great deal of uncertainty surrounding estimates of biogenic emissions. Moreover, little is known concerning precisely how these emissions change in response to climatic and vegetation changes. Additional research is needed to determine how climate changes (such as temperature) and land cover changes (such as conversion of forests to open grasslands) affect biogenic emissions and how to incorporate these changes into emissions models.

An important feature of this research is the long time frame (50–100 years) involved when considering global change. In general, the current tools used to estimate emissions do not have the capability to capture such long-term changes. For example, it is entirely reasonable when estimating next year's emissions to assume that communities, roads, factories, and trees will be in the same locations and look much the same as they do today. However, 50 years from now this assumption is unlikely to hold true. As a result, it is necessary to develop new models or augment existing ones to project emissions. A key goal of this research is improved methods to allocate emissions spatially. Methods are needed to allow the spatial allocation algorithms to change over time in response to movements of economic activities, communities, and roads.

Proposals must demonstrate the feasibility of new methods. An important goal is to produce methods for creating plausible North American emission scenarios for air quality models such as the Models-3

Community Multiscale Air Quality model for 50 years into the future. For air quality modeling purposes, future regional emission scenarios are needed at the resolution of 36 km × 36 km grids, with finer resolution desirable in urban regions or areas of complex terrain. To the extent possible, future emission scenarios should be consistent with the continental-scale emissions scenarios from the *Special Report on Emissions Scenarios* of the Intergovernmental Panel on Climate Change, but should not be overly restricted to them because of the regional and local concentration of anthropogenic emission sources. Because of the assumptions implicit in modeling of emissions, it is important to document the spatial and temporal allocation methods developed, and the basis and uncertainty in future emission scenarios, including location and quantities. It is likely that a range of emission scenarios will be needed to realistically allow for uncertainties.

Successful proposals for this solicitation will address one or more of the following three research topics:

1) *Changes in the spatial distribution of stationary source emissions due to regional development patterns and technology changes.* This topic includes research on the drivers of anthropogenic air pollutant emissions and how they will change and be manifested spatially over time across North America. Research should account for land use, technology, and possible public policy changes in the development of future year (2050–2100) emission scenarios. Because there are many categories of anthropogenic pollution sources, it may be prudent to focus on those large emission sectors likely to experience the greatest changes. Currently, most emissions data for the United States are estimated and aggregated by state and county. Besides electric generating units, few emissions sources are reported by their specific location. Instead, they are spatially allocated to grids used by air quality modelers by means of geographic information system–based coverage files of surrogate data thought to be related to the emissions. For example, emissions from residences may be spatially allocated by a geographic coverage of population data. This approach is more difficult to apply when addressing future emissions, where both the emissions and spatial surrogate data change. Consequently, research on methods of spatially allocating future year emissions is needed as part of responding to research questions concerning spatial distribution of future emissions.

2) *Changes in the spatial distribution of mobile source emissions due to the interactions between climate, land use, and technology change and regional transportation systems.* The EPA is seeking proposals that address gaps in the methodologies for assessing the impact of long-term changes (such as in climate, land use, economic activity, technology improvements) on the transportation sector and resultant air pollutant emissions. The spatial and temporal distribution of transportation activities and emissions are of key concern. For example, regional development patterns (housing, roads, commercial development, mass transit systems) will likely be heterogeneous across the country, affecting both the amount and the spatial distribution of air pollution emissions from mobile sources. Similarly, improved automobile engines will likely diffuse into the nation's fleet over time and will penetrate faster in some areas than in others. Understanding the process of technological diffusion will improve our ability to estimate air pollutant emissions.

In order to develop more accurate long-term (for example, to 2050 and 2100) emissions projections, current energy modeling systems on which aggregate forecasts of emissions are based will need to incorporate or develop better methods to project changes in a wide range of key driver and policy variables, including transportation infrastructure investments, regional development patterns, transportation modal choices (and other lifestyle factors), air quality and climate policies, and population movements, in addition to technological change, which has been the focus of much recent work. Furthermore, methodologies will need to be developed to spatially distribute the emissions resulting from these kinds of inputs across North America. In addition, mobile source emissions may also be affected by changes in climate directly (such as increased temperatures resulting in higher evaporative emissions) and indirectly (such as warmer weather leading to people taking more trips, using air conditioners more).

3) *Changes in the spatial distribution and quantity of biogenic emissions due to land-use, vegetation, and climate changes.* This topic includes research that addresses methodologies for assessing changes in biogenic emissions due to long-term changes in land use, vegetation, and climate. Land use and vegetation are known to influence the natural emission of VOCs, carbon monoxide, and oxides of nitrogen. Biogenic VOC emissions are also the largest source of global secondary organic aerosols. Little is known concerning how climate and land use change may affect biogenic secondary organic aerosol production.

Previous research findings suggest a range of continental-scale natural ecosystem responses as well as more regional, species-specific responses to climate change scenarios. In contrast, there has been limited modeling regarding future patterns of land use and vegetation change (such as that due to regional development or wildfire management strategies) in combination with climate-driven natural and managed vegetation change.

Existing biogenic emissions models have been used to estimate biogenic emissions using highly resolved meteorological (1 hr/32 km) and land use/land cover (1 km) data. Vegetation types and climatic variables, such as temperature and solar radiation, strongly influence the rate of emitted biogenic compounds. Although biogenic emissions can make a significant contribution to total VOC emissions, a high degree of uncertainty is associated with these estimates, including how they respond to changes in weather variables. Biogenic emission model requirements for expanded species detail at relatively fine spatial resolution add to the challenge of developing emission scenarios for future climate conditions.

It is anticipated that a total of approximately $8 million will be awarded, depending on the availability of funds. The EPA anticipates funding approximately 12–15 grants under this request for applications. The projected award per grant is $150,000–250,000 per year total costs, for up to 3 years. Requests with EPA funding amount in excess of $750,000, including direct and indirect costs, will not be considered.

The deadline for receipt of applications is 9 April 2003. Submission instructions, including the necessary forms, are available at http://es.epa.gov/ncer/rfa/forms/. Complete information on this announcement is available at http://es.epa.gov/ncer/rfa/current/2003_global_change.html.

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